

REMARKS

Claims 9-16 and 48-66 as amended, are currently pending for the Examiner's review and consideration. Claim 9 has been amended to more accurately recite Applicant's invention, to remove the numerical limitation on pressure, and to recite a specific metal removal rate. As no new matter has been added by these amendments or the following remarks, Applicant respectfully requests entry of these amendments and remarks into the record of the above-captioned application.

The Rejection Under 35 U.S.C. § 112 Should be Reconsidered and Withdrawn

Claims 9, and claims 11-16, 48-56 and 65 depending therefrom, were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The office action indicates that the above identified claims contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Specifically, the examiner points out that the new range of pH 6-9 that was incorporated in the previous amendment to Claim 9 is not described in the original disclosure such that it is envisaged by the original disclosure – that page 8, lines 10-11 describe a range of 4-12; page 58, line 18 describe a range of 7-9, and “multiple examples” having pH values of 1.5, 2, 2.5, 3.6, and 6.

Applicant respectfully traverses this contention. There are several examples at low pH disclosed in the instant specification in Example 4, on page 58 at lines 20-29. ALL of these tests reflect polishing rates below the lowest useful rate of 500 angstroms per minute (“A/minute”). See the specification, page 5, lines 1-3, which states that, while metal etch rates of 500 A/minute may be acceptable, “the metal removal rate should be between 1700 and 3500 A/minute.” However, in these low pH tests there was a clear increase in polishing rate with pH. The pressure and RPM were quite low in these tests, and these values were increased in the subsequent tests.

The next paragraph, at page 59, lines 1-6, says “numerous tests were performed using 2% periodic acid formulations at pH 6,” at the higher pressure and RPM values, and polishing rates

ranged from 2600 A/minute to 3660 A/minute were demonstrated. This second series of tests had the metal removal rates not just within the useful range of between 500 and 7000 A/minute, but the metal removal rates were generally within the much narrower preferred range.

The claimed range need not be recited verbatim. Rather than a random collection of tests at pH values of 1.5, 2, 2.5, 3.6, and 6 as characterized in the Office Action, there was a series of low pressure/low pH tests which, while not providing acceptable metal removal rates, clearly showed the removal rate increased with pH. There was then reported a second series of tests at pH 6, which exhibited metal removal rates with the acceptable range and generally within the preferred range.

Applicants have amended claim 9 to recite that the claimed method provide acceptable metal removal rates, i.e., a metal removal rate greater than 500 A/minute.

Applicant would also like to point out that on page 14, lines 5-6 of the original specification, Applicant envisages a pH range of about 6 to about 9 when hydroxylamine formulations are used as an oxidizer, along with a second oxidizer (selected from a group that includes periodic acid). As noted by the Examiner, Applicant expresses that a tungsten polishing formulation using periodic acid has a preferred range of about 7 to about 9 (See original specification, page 11, line 30). Therefore, at the time of invention, Applicant did envisage an preferred pH range extending beyond 7-9. There were a plurality of experiments at pH 6 showing metal removal rates within the accepted and also the preferred ranges. There were no experiments showing an acceptable polishing rate at pH values below 6. Applicants contend this is adequate support for the recited pH range in claim 9.

The Rejections Under 35 U.S.C. § 103(a) by Combination of Streinz, et al. and Scherber, et al. Should be Reconsidered and Withdrawn

Claims 9-12, 14-16, 58-60 and 62-66 were rejected under 35 U.S.C. § 103(a), as being obvious over the combination of U.S. Patent Nos. 5,993,686 to Streinz *et al.* ("Streinz") and 5,858,813 to Scherber *et al.* ("Scherber") on pages 2-5 of the Office Action. Claims 9, 10 and 58 are independent claims with different scope, and will therefore be discussed independently when appropriate. Claims 11-12, 14-16, and 64 are dependent on Claim 9. Claims 59, 60, 62, 63, 65 and 66 are dependent on Claim 10.

The Office Action indicated that Streinz allegedly teaches a method of polishing tungsten and a dielectric material using a polishing composition comprising periodic acid and malonic acid in the claimed ranges, as well as a pH adjusting compound wherein the pH of the composition is about 4-5. As the office action points out, Streinz fails to disclose the pressure used during the chemical mechanical polishing. The office action further alleges that Scherber teaches that a useful pressure range for chemical mechanical polishing of tungsten (col. 10, line 19) includes 5 psi. However, Applicant respectfully traverses and respectfully submits that Streinz, alone or in combination with Scherber, does not teach the invention as currently claimed.

We note that Streinz teaches a composition useful to polish tungsten and comprising an abrasive, an oxidizing agent, and a fluoride additive. Streinz does not fairly teach the limitations of claims 9, 10, or 58.

Streinz alone, or in combination with Scherber, does not teach all of the claim limitations of the present invention. As the office action points out, Streinz is silent on the pressure used for chemical mechanical polishing.

Further, citing Streinz at col. 5, lines 38-40, the examiner indicates on page 4 of the office action that polishing, for example, a copper plug over a Ti-W barrier layer, at pHs above 5.0, would have been obvious to one of ordinary skill in the art. However, the Streinz disclosure at lines 26-32, specifically *teaches away* from using pH above about 5.0 when polishing tungsten. Merely because official notice is taken by the examiner that combination polishing of tungsten and another metal (for example, copper) is known, that does not overcome the teaching of Streinz, i.e., that *any* polishing of tungsten must be performed at pH values below 5.0 in order to fall under the scope of the Streinz invention, due to an increased tungsten corrosion at higher pH values. A polishing composition with a pH above about 5.0, according to the Streinz reference, *must not* contact tungsten even when the tungsten is a barrier layer under another metal, such as copper.

Further, there is no motivation, either in Streinz or, indeed, in any other cited prior art, to alter the teaching of Streinz with regard to polishing composition pH with a tungsten substrate. In fact, as mentioned above, Streinz specifically *teaches away* from using pH above about 5.0 when polishing tungsten.

In addition, Scherber does not remedy the deficiencies of Streinz because Scherber does not disclose any pH ranges, no less the pH values recited in Claim 9. While in most areas, the teachings of Scherber are similar to those of Streinz, Scherber is silent as to pH and certainly does nothing to suggest that pH values higher than 5.0 for tungsten polishing compositions would be acceptable (*e.g.*, would not corrode tungsten).

Therefore, the prior art, *i.e.*, Streinz, or Streinz in combination with Scherber do not teach all the elements of the present invention. If anything Streinz taught away from using a pH above 5. The present invention generally teaches a pH higher than 5. Therefore, the teachings of the Streinz, or Streinz in combination with Scherber are insufficient to render the claims *prima facie* obvious. For at least this reason, Applicant respectfully submits that the prior art does not render claims 9-12, 14-16, 58-60 and 62-66 of the present invention obvious under 35 U.S.C § 103 (a).

Even if the references did meet the burden of teaching or suggesting all the elements of the claimed invention, the second prong of the obviousness inquiry, *i.e.*, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings is not satisfied. See *In re Lee*, 277 F.3d 1338 (Fed. Cir. 2002). Neither Streinz, nor Scherber suggest or provide motivation to combine the references. In fact, Scherber is completely silent as to chemical mechanical polishing of tungsten and as to the pH range that can be used for the process. Therefore, there is no suggestion or motivation, either in Streinz or in Scherber or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to teach or suggest this claim limitation. For this additional reason, Applicant respectfully submits that the prior art does not render obvious claims 9-12, 14-16, 58-60 and 62-66 of the present invention.

Similarly, the third prong of the obviousness inquiry, *i.e.*, that there must be a reasonable expectation of success, is not satisfied. Evidence showing that there was no reasonable expectation of success may support a conclusion of nonobviousness. MPEP § 2143.02, citing *In re Rinehart*, 531 F.2d 1048 (CCPA 1976). Because Streinz teaches away from using a pH above 5, and because Scherber does not teach chemical mechanical polishing of tungsten, there cannot be a reasonable expectation of success if the two references are combined. For this additional reason, Applicant respectfully submits that the prior art does not render obvious claims 9-12, 14-16, 58-60 and 62-66 of the present invention.

Accordingly, Applicant respectfully requests that this rejection of Claims 9-12, 14-16, 58-60 and 62-66, under 35 U.S.C. § 103(a) be reconsidered and withdrawn. Furthermore, since Claims 11, 12, 14, 15, 16, 59, 60, are dependent on Claim 9 or 10, and Claim 58 has also been modified to include a pH range from about 6.5 to 9. Therefore, the additional element of Claim 9 and 58, i.e., the pH range being from about 6.5 to about 9, should render the dependent claims nonobvious over Streinz.

The Rejections Under 35 U.S.C. § 103(a) by Combination of Streinz, et al. and Scherber, et al. in view of Nakagawa Should be Reconsidered and Withdrawn

Claims 9-12, 14-16, 58-66 were rejected under 35 U.S.C. § 103(a), as being unpatentable over the combination of U.S. Patent Nos. 5,993,686 to Streinz *et al.* ("Streinz") and 5,858,813 to Scherber *et al.* ("Scherber"), and further in view of U.S. Patent No. 5,700,389 to Nakagawa ("Nakagawa") on page 5 of the Office Action. Claims 9, 10 and 58 are independent claims. Claims 11, 12, 14, 15, 16, and 64 are dependent on Claim 9. Claims 59, 60, 62, 63, 65 and 66 are dependent on Claim 10.

Further, the Office Action indicates that Nakagawa discloses the addition of imidazole to the composition as a useful additive to etching solutions to increase the etch rate and prevent rust. Thus, the Office Action asserts that the combination of Nakagawa with Streinz and Scherber renders obvious claim 61.

Applicant respectfully traverses these rejections for the following reasons:

First, there is no motivation to combine Nakagawa with Streinz and/or Scherber. Nakagawa teaches an etching solution for "preventing rusting of the copper or copper alloy surface and for roughening the surface" (see Nakagawa, column 1, lines 6-9). CMP is the exact opposite of roughening. The goal of CMP is to make a smooth, flat surface. See Streinz, column 2, lines 3-6. No one of ordinary skill in the art would be motivated to incorporate a roughening agent for copper into a chemical mechanical polishing slurry used for tungsten.

While Nakagawa may teach addition of imidazole to an oxidizing composition (see Nakagawa at column 2, lines 11-16), it also discloses compositions for etching copper or copper alloys (see *id.* at Abstract and column 1, lines 6-10). Etching compositions are not CMP

compositions, and copper/copper alloy surfaces are not tungsten surfaces, both as required by the instant claims. Also, Nakagawa teaches that its etching solution “does not oxidize the copper surfaces after etching” (See Nakagawa abstract), whereas the present invention, in fact, recites a chemical mechanical polishing, which necessarily results in the oxidation and abrasive removal of the metallic substrate (tungsten).

Further, Nakagawa teaches away from the periodic acid oxidizer instantly claimed and teaches a preference for a persulfate oxidizer. *See Id.* at column 1, line 46. Likewise, Nakagawa teaches away from the elected malonic acid component recited in independent claim 10 and teaches a preference for an inorganic acid and/or a component of amidosulfuric acid or an aliphatic sulfonic acid. *See Id.* at column 1, lines 45-54. For any of the foregoing reasons, one of ordinary skill in the art would not have been motivated to combine Nakagawa with Streinz, Scherber, or both, nor would there have been a reasonable expectation of success in picking and choosing elements from Nakagawa in combination with those from Streinz and/or Scherber to attain the instantly claimed invention.

In any event, even if one of ordinary skill would be motivated to combine this art, Nakagawa does not remedy the deficiencies of Streinz and Scherber, since it does not teach a pH value of its composition from 6 to 9. Indeed, Nakagawa, as with Scherber, is silent as to compositional pH.

Thus, for at least the foregoing reasons, Applicant respectfully submits that claims 9-12, 14-16, and 58-66, as amended, are distinguishable from Nakagawa, Streinz, Scherber, or any combination thereof. As a result, Applicant respectfully requests that the obviousness rejection of claims 9-12, 14-16, 58-66 be reconsidered and withdrawn.

CONCLUSIONS

Applicant respectfully submits that the application is now in condition for allowance, early notice of which would be appreciated. Should the Examiner disagree, Applicant respectfully requests that the undersigned be contacted to resolve any remaining issues forestalling allowance of the claims.

No fee is believed to be due for this submission, as the 27 total pending claims are less than the 42 claims for which Applicant has previously paid. Should any fees be due, however, please charge the required fees to Morgan Lewis & Bockius LLP Deposit Account No. 50-3010.

Respectfully submitted,

Date: January 21, 2005

A handwritten signature in cursive script, appearing to read "Christopher G. Hayden", is written over a horizontal line.

Christopher G. Hayden (Reg. No. 44,750)

Morgan, Lewis & Bockius LLP
1111 Pennsylvania Avenue, N.W.
Washington, D.C. 20004
Tel (202) 739-3000